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(54) **ROD HANGER AND CLAMP ASSEMBLY**

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(58) **Field of Search** 166/68.5, 85.1, 166/75.14, 96.1, 94.1, 85.5, 382, 379, 78.1; 248/541, 74.1, 411, 413, 527; 175/325.7; 285/123.12, 123.4

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(57) **ABSTRACT**

An apparatus and method is provided which holds a rod or tubular within a well, allowing a well service provider or operator to safely and more cost effectively disassemble, remove, or otherwise work on a drive assembly. In one aspect, the apparatus comprises an annular body having at least one radial aperture formed therethrough and at least one rod holder disposed through each aperture. The rod holder comprises a push jaw disposed on a first end of a screw. In one aspect, the method comprises shutting down a drive assembly and supporting a rod or tubular with an annular body comprising at least one radial aperture formed there-through, at least one threaded member disposed within the aperture, and at least one push jaw disposed on a first end of the threaded member.

26 Claims, 3 Drawing Sheets

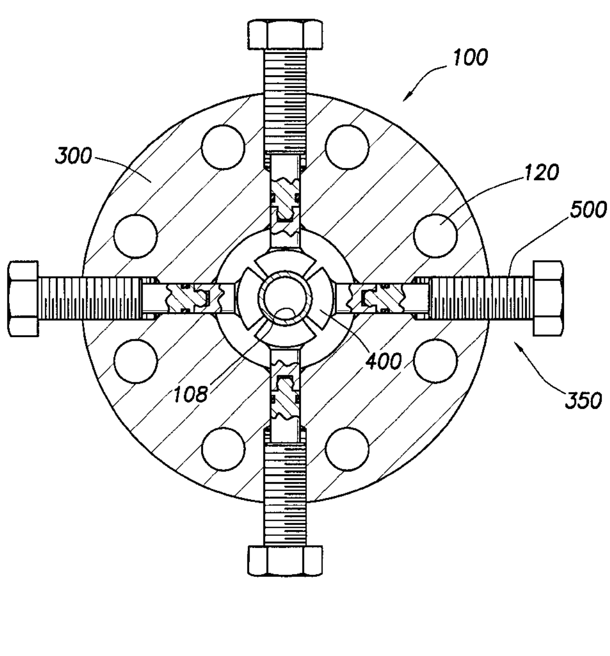
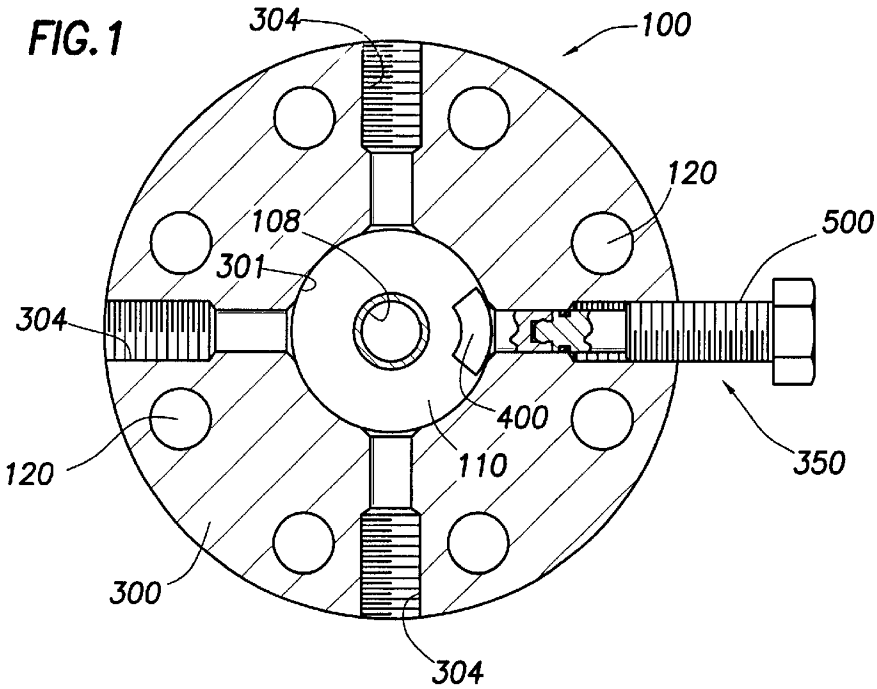


FIG. 1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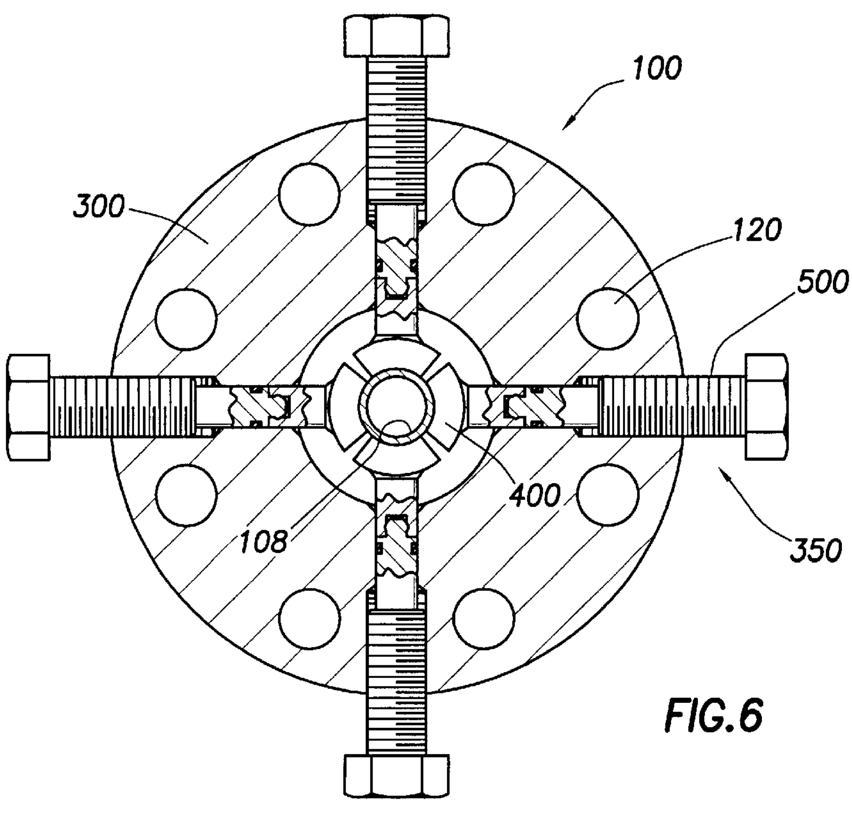
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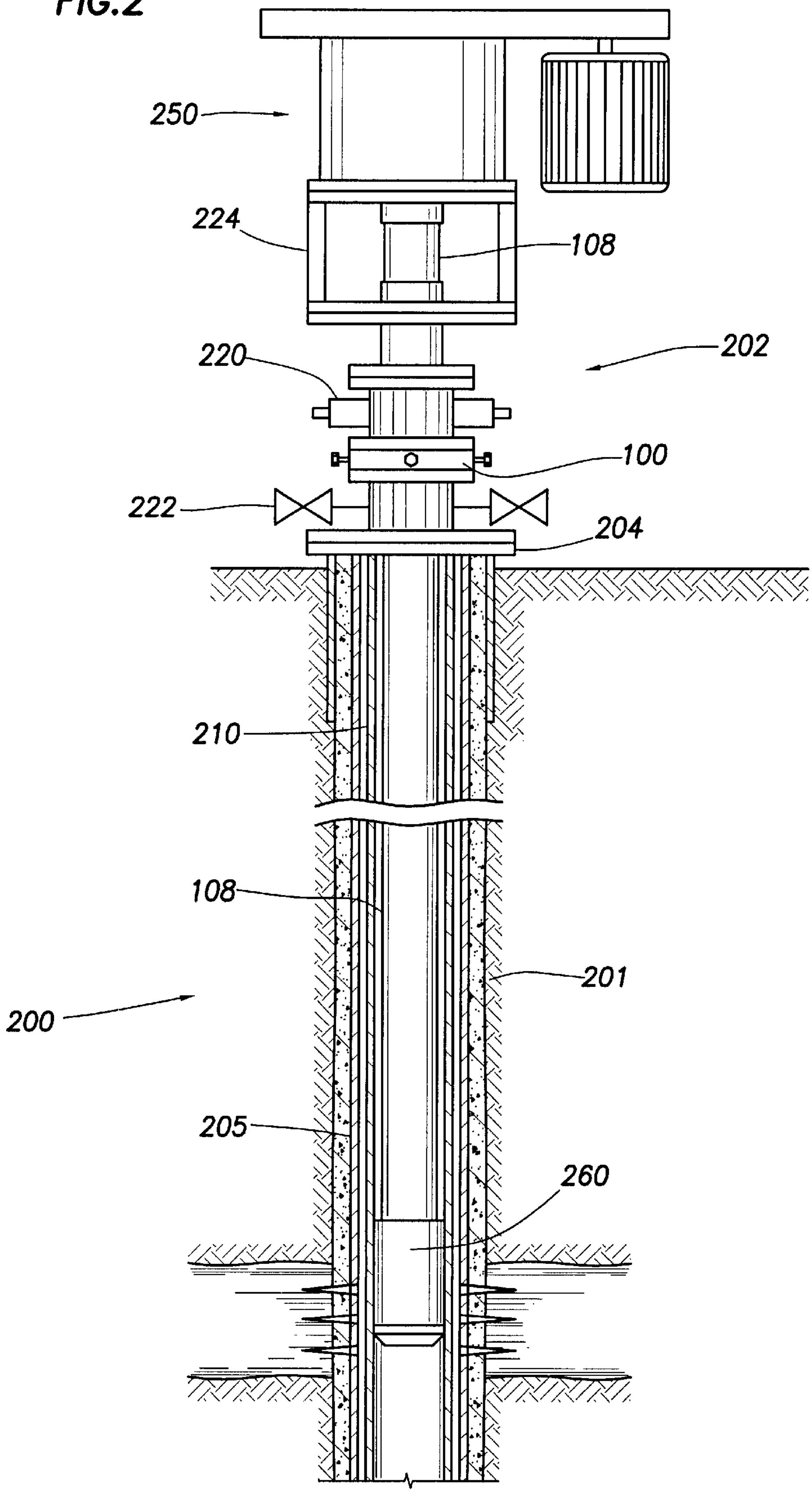
FIG. 6

FIG.2



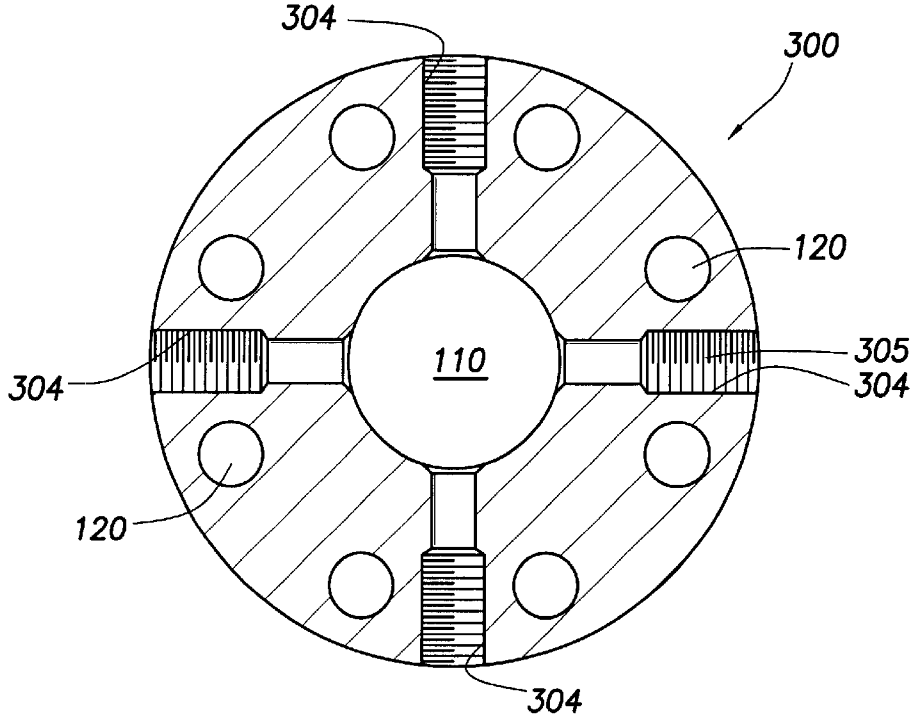


FIG.3

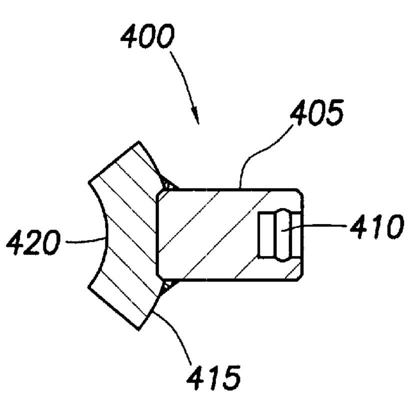


FIG.4

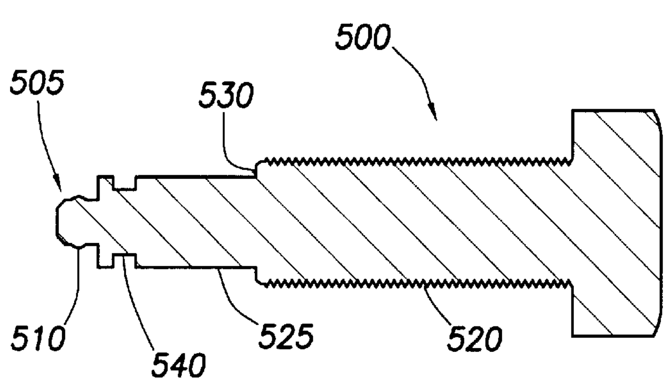


FIG.5

ROD HANGER AND CLAMP ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a wellhead component for holding and supporting the weight of a downhole rod or tubular. More particularly, the present invention relates to a clamping device to hold and support the weight of a downhole rod to facilitate the removal or repair of a surface drive assembly.

2. Background of the Related Art

Oil and gas in newly discovered reservoirs usually flow to the surface by natural lift. The natural formation pressure of a reservoir provides the energy or driving force to move reservoir fluids horizontally into a wellbore, through production tubing, and through surface processing equipment. During the life of any producing well, however, the natural reservoir pressure decreases as reservoir fluids are removed from the formation. As the natural downhole pressure drops to the sum of the hydrostatic head in the wellbore and the facility pressure, the fluids cease to spontaneously flow to the surface. Therefore, artificial lift methods such as sucker-rod pumping, downhole pumping, and gas injection lift techniques, for example, are employed to lift the fluids to the surface.

Many wells today use a downhole pumping apparatus such as a progressing cavity pump (PCP) system to lift fluids from within the production well to the surface. A PCP system consists of a progressing cavity pump located within the wellbore and a motor-driven drive assembly located at the surface of the well. The pump and the motor are connected by a rod string disposed within the production tubing. The progressing cavity pump consists of a rotor disposed within a stator located within the production tubing. The rotor is driven by the rod string which is supported and rotated by the motor-driven drive assembly. The well is produced by rotating the rod string which drives the rotor of the pump resulting in a non-pulsating positive displacement flow of fluids toward the surface of the well.

A problem occurs when the drive assembly requires routine servicing or maintenance after a period of use. Typically, when servicing an assembly, the motor is first shut down and the rod string is allowed to backspin. The rod string is much like a rubber band or other elongated elastic member due to its length. As a result, the rod string possesses accumulated potential energy due to the continuous twisting motion created by the drive motor. The accumulated "winding up" converts into kinetic energy once the drive motor is released or removed. Consequently, the rod string unwinds by rotating in an opposite direction.

Even after the rod string has stopped back-spinning upon the initial shutdown, a sudden jerk or bump to the drive or rod string itself may release residual energy retained in the system and cause the rod string to uncontrollably back-spin. This presents a safety risk to the personnel standing on the wellhead trying to disconnect the drive from the rod string. Also, the spinning rod may damage other equipment nearby.

One method to safely remove a drive assembly from a rod string is to independently hold and support the weight of the rod string prior to removing the drive. Presently, the rod string is clamped to a rig which is secured to a vehicle. Once the rod string has been supported by the vehicle, a second vehicle is typically used to lift and remove the drive assembly from the supported rod string. These steps are then

repeated in reverse order to re-connect the drive to the rod string. This method is complex, costly, and time consuming.

Therefore, there is a need for a method and apparatus to facilitate the servicing and/or replacement of progressing count pump components. There is a further need for holding and supporting the weight of a rod string to facilitate an efficient and safe removal of a drive assembly from the rod string.

SUMMARY OF THE INVENTION

A rod hanger and clamp is provided to hold a rod or tubular within a well, allowing a well service provider or operator to safely and more cost effectively disassemble, remove, or otherwise work on a drive assembly. In one aspect, the rod hanger and clamp comprises an annular body having at least one radial aperture formed there-through and a rod holder disposed through each aperture. The rod holder comprises a push jaw disposed on a first end of a threaded member. A well service provider or operator may apply a torque to the threaded member to urge the push jaw against an outer surface of a tubular disposed within a well, thereby holding the tubular in place.

In another aspect the invention provides a method of holding and supporting a tubular within a wellbore comprising shutting down a drive assembly, allowing the tubular to back-spin, and supporting the tubular with an annular body having at least one radial aperture formed therethrough and, at least one threaded member disposed within the aperture. The threaded member has a push jaw to secure the tubular.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the manner in which the above recited features, advantages and objects of the present invention are attained and can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to the embodiments thereof which are illustrated in the appended drawings.

It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

FIG. **1** is a cross section of a rod hanger and clamp of the present invention.

FIG. **2** is a schematic view of a rod hanger and clamp of the present invention in use with a progressing cavity pump artificial lift system disposed within a wellbore.

FIG. **3** is a partial cross section of an annular body of the rod hanger and clamp.

FIG. **4** is a cross section of a rod holder push jaw.

FIG. **5** is a cross section of a threaded member.

FIG. **6** is a cross section of the rod hanger and clamp in an activated position having a rod or tubing string secured therein.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** is a cross section view of a rod hanger and clamp **100** according to one aspect of the invention. The rod hanger and clamp **100** may be used to hold, retain, and support any rod, rod string, or tubular extending into a wellbore. For clarity and ease of description, however, the rod hanger and clamp **100** will be further described as it relates to a rod string **108** in an artificial lift operation such as progressing cavity pumping (PCP).

The rod hanger and clamp **100** comprises an annular body **300** having one or more radially extending apertures **304** formed there-through. Each radial aperture **304** houses a rod holder **350** which engages an outer surface of rod **108** disposed within the annular body **300**. An annulus **110** is formed between an inner surface **301** of the body **300** and an outer surface of the rod **108**. The rod holder **350** includes a push jaw **400** disposed at an end of a partially threaded member **500**. The annular body **300** also includes a plurality of vertical apertures **120** formed there-through to house a screw or bolt (not shown) which may be used to fasten the rod hanger and clamp **100** within a stack of wellhead components such as those illustrated in FIG. **2**.

FIG. **2** is a schematic view of a well **200** having a possessive cavity pump **260** disposed within a wellbore **201**. The rod hanger and clamp **100** is disposed within a stack **202** of wellhead components. The stack **202** typically includes a casing head **204** which is mounted at the surface of the well to a casing string **205** which lines the wellbore **201**. The stack **202** also typically includes a blowout preventer **220**, a production tee **222**, which may be integral with the blowout preventer **220**, and a stuffing box **224**. The stuffing box **224** serves to seal around the rod **108** where the rod **108** is inserted into the well **200**, and is known to those skilled in the art.

A drive assembly **250** for a downhole PCP **260** is disposed at the top of the stack **202**, and is typically disposed directly on top of the stuffing box **224**. The rod hanger and clamp **100** of the present invention is preferably disposed below the drive assembly **250** and above the production tee **222**. The rod **108** is run through the wellhead and into the wellbore **200** through a pathway which extends through each of the components **202** of the wellhead stack. The weight of the rod **108** is supported by the drive assembly **250**. The PCP **260** consists of a rotor disposed within a stator and is disposed below the surface within production tubing **210**. The rotor is driven by the rod **108** which is supported and rotated by the drive assembly **250**. During production, the drive assembly **250** rotates the rod **108** which drives the rotor of the pump **260** resulting in a non-pulsating positive displacement flow of fluids toward the surface of the well **200**.

FIG. **3** is a partial cross section of the annular body **300** of the rod hanger and clamp **100**, wherein the rod holders **350** are not shown so that the plurality of equally spaced radial apertures **304** are clearly visible. The apertures **304** have an at least partially threaded inner surface **305** to engage an outer surface of a threaded member **500**.

FIG. **4** is a cross section view of the push jaw **400**. The push jaw **400** comprises a first portion **405** having a female snap connect **410** at the end thereof for attachment to a threaded member **500**. The push jaw **400** further comprises a second portion **415** having an outer surface **420** which substantially conforms to an outer surface of the rod **108** (not shown) extending from the wellbore. For example, the outer surface **420** of the push jaw **400** may be configured to substantially conform to a rod **108** having a round or polygonal outer surface. The outer surface **420** of the push jaw **400** may also include teeth or serrations to better grip and hold the outer surface of the rod **108**.

FIG. **5** is a cross section of the threaded member **500**. The threaded member **500** comprises a first end **505** having a male snap connect **510** which is insertable within the female snap connect **410** of the push jaw **400**. The threaded member **500** also comprises a threaded section **520** and a non-threaded section **525**. The threaded section **520** has a larger circumference or outer diameter than the non-threaded section **525**. The different outer diameters **520, 525** form a shoulder **530** between the threaded **520** and non-threaded sections **525**. The shoulder **530** acts as a stop to prevent the threaded member **500** from over-advancing within the aperture **304** of the annular body **300**. The threaded member **500** further includes a recessed groove **540** disposed in an outer surface thereof between the first end **505** and the non-threaded section **525** of the threaded member **500**. An O-ring (not shown) or any other known means for sealing can be used with the groove **540** to provide a fluid-tight seal around the threaded member **500**.

In operation, the drive assembly **250** is first shut-down or turned off. The rod **108** is then allowed to back-spin, releasing most built-up rotational stress within the rod **108**. Torque is thereafter applied to the rod holders **350** to advance the rod holders **350** within the apertures **304**. The threaded members **500** are advanced until a predetermined force is applied to the rod **108**. Specifically, as the rod holders **350** advance toward the center of the annular body **300**, the push jaws **400** that are attached to the first ends **505** of the rod holders **350**, engage the outer surface of the rod **108** thereby holding the rod **108** in place. The rod **108** is then held both rotationally and axially within the wellbore **201**.

FIG. **6** shows a cross section of an actuated rod hanger and clamp **100**. As shown, the rod holders **350** have advanced within the apertures **304** engaging the curved surface **420** of the push jaw **400** against the outer surface of the rod **108**. Once engaged, the weight of the rod **108** is independently held and supported by the rod hanger and clamp **100** so that the drive assembly **250** may be removed and serviced.

While foregoing is directed to the preferred embodiment of the present invention, other and further embodiments of the invention may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

What is claimed is:

1. A rod hanger and clamp assembly, comprising:

an annular body disposable around a rod having at least one radial aperture formed there-through, wherein the at least one radial aperture comprises a first threaded inner diameter that is larger than a second non-threaded inner diameter and a shoulder;

at least one rod holder disposable through the at least one radial aperture, the at least one rod holder having a first threaded outer diameter for mating with the first threaded inner diameter of the at least one radial aperture and a stop formed on the outer diameter to prevent axial movement of the at least one rod holder within the at least one radial aperture; and

a retaining member removably disposed on one end of the at least one rod holder, whereby the at least one rod holder is adjustable within the at least one aperture for applying a predetermined radial force on the rod and thereby supporting a weight of the rod when the predetermined force is applied.

2. The rod hanger and clamp assembly of claim **1**, wherein the at least one radial aperture includes a partially threaded inner surface and the at least one rod holder includes a partially threaded outer surface.

3. The rod hanger and clamp assembly of claim **1**, wherein the retaining member comprises a push jaw.

4. The rod hanger and clamp assembly of claim **3**, wherein the push jaw includes a first end which substantially conforms to an outer surface of the rod.

5. The rod hanger and clamp assembly of claim 4, wherein radial advancement of the at least one rod holder urges the first end of the push jaw against the outer surface of the rod.

6. The rod hanger and clamp assembly of claim 4, wherein the rod is held and supported by the rod hanger and clamp assembly.

7. The rod hanger and clamp assembly of claim 1, wherein the annular body has four radial apertures and four rod holders disposable therein.

8. The rod hanger and clamp assembly of claim 1, wherein the at least one rod holder comprises a non-threaded first outer surface and a threaded second outer surface.

9. The rod hanger and clamp assembly of claim 8, wherein the threaded second outer surface of the at least one rod holder engages a threaded inner surface of the at least one aperture.

10. The rod hanger and clamp assembly of claim 1, further comprising at least one vertical aperture formed within the annular body for attaching the rod hanger and clamp assembly within a stack of wellbore components.

11. The rod hanger and clamp assembly of claim 1, wherein the annular body is disposed within a stack of wellbore components below a motor-driven drive assembly.

12. The rod hanger and clamp assembly of claim 1, wherein the annular body is disposed about the rod.

13. The rod hanger and clamp assembly of claim 1, wherein the at least one rod holder comprises a groove.

14. The rod hanger and clamp assembly of claim 1, wherein the at least one rod holder comprises a second outer diameter smaller than the first threaded outer diameter.

15. The rod hanger and clamp assembly of claim 1, wherein the rod comprises a tubular.

16. The rod hanger and clamp assembly of claim 1, wherein the stop is constructed and arranged to mate with the shoulder.

17. A rod hanger and clamp assembly for use with a drive assembly, comprising:

an annular body disposed below the drive assembly, the annular body having at least one aperture formed there-through, wherein the at least one radial aperture comprises a first threaded inner diameter that is larger than a second non-threaded inner diameter;

at least one threaded member disposed within the at least one aperture, the at least one threaded member engaging the first threaded inner diameter of the at least one aperture; and

at least one push jaw disposed on a first end of the at least one threaded member, wherein the rod hanger and clamp assembly is capable of holding and supporting a rod.

18. The rod hanger and clamp assembly of claim 17, wherein the at least one threaded member has an at least partially non-threaded outer surface.

19. The rod hanger and clamp assembly of claim 17, wherein the at least one push jaw comprises a first end which substantially conforms to an outer surface of the rod that is disposed through the annular body.

20. The rod hanger and clamp assembly of claim 19, wherein radial advancement of the at least one threaded member forces the first end of the at least one push jaw against the outer surface of the rod thereby holding and supporting the rod.

21. A method of holding and supporting a rod within a wellbore, comprising:

shutting down a motor-driven drive assembly;

allowing the rod to back-spin; and

supporting the rod with an annular body comprising:

at least one radial aperture formed there-through;

at least one threaded member disposed within the at least one aperture; and

at least one push jaw disposed on a first end of the at least one threaded member, wherein the rod is supported by applying a radial force to the rod.

22. The method of claim 21, wherein the annular body is disposed on a wellhead between a wellhead casing flange and the motor-driven drive assembly.

23. The method of claim 21, wherein rotation of the at least one threaded member forces a first end of the at least one push jaw against an outer surface of the rod thereby holding and supporting the rod.

24. A method of holding and supporting a rod within a wellbore, comprising:

shutting down a rod drive assembly; and

supporting the rod with an annular body comprising:

at least one radial aperture formed there-through, wherein the at least one radial aperture comprises a first threaded inner diameter that is larger than a second non-threaded inner diameter;

at least one threaded member disposed within the at least one aperture, wherein the at least one threaded member is arranged to mate with the first threaded inner diameter of the at least one aperture; and

at least one push jaw disposed on a first end of the at least one threaded member, wherein the rod is held and supported by applying a radial force to the rod.

25. The method of claim 24, wherein rotation of the at least one threaded member forces a first end of the at least one push jaw against an outer surface of the rod thereby holding and supporting the rod.

26. The method of claim 24, wherein the annular body prevents torsional spin of the rod.

* * * * *